The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A magnetic separator for charged particle beam separation that provides a linear dispersion of the charged particles proportional to their mass-energy-to-charge ratio, wherein the linear dispersion is achieved by an inhomogeneous magnetic field.

2. The magnetic separator of Claim 1 wherein the linear dispersion of charged particles proportional to their mass-energy-to-charge ratio is achieved by an inhomogeneous magnetic field in one plane and a homogeneous magnetic field in another plane.

3. The magnetic separator of Claim 1 wherein the linear dispersion of the charged particles proportional to their mass-energy-to-charge ratio is along a plane.

4. The magnetic separator of Claim 1 further comprising a transverse gradient magnetic field for focusing uncollimated charged particle beams.

5. The magnetic separator of Claim 1 comprising a single magnet.

6. The magnetic separator of Claim 5 wherein the magnet comprises two poles separated by a gap through which pass charged particle beams.

7. The magnetic separator of Claim 5 wherein the gap separating the poles increases at a rate along the path of the charged particle beams such that the magnetic field decreases as a function of the distance from entrance of the magnet.

8. The magnetic separator of Claim 1 wherein the magnetic field varies according to the function $B(x) = B_o x^{-3/4}$, where B_o is a magnetic field constant chosen to match a nominal magnetic field and x is a distance measured along the separator's centerline axis.

9. The magnetic separator of Claim 6 wherein the gap between the poles varies according to the function $g(x) = \tan (x^{-1/4})$, where x is a distance measured along the pole surface.

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10. The magnetic separator of Claim 6 wherein the poles receive magnetic induction by an electric field.

11. The magnetic separator of Claim 6 wherein the poles receive magnetic induction by permanent polarized hard magnetic material.

12. The magnetic separator of Claim 11 wherein the magnetic material is selected from the group consisting of ferrite and rare-earth permanent magnetic materials.

13. The magnetic separator of Claim 6 wherein the poles comprise a highly permeable soft magnetic material.

14. The magnetic separator of Claim 11 wherein the soft magnetic material comprises an iron-cobalt alloy.

15. The magnetic separator of Claim 14 wherein the iron-cobalt alloy comprises vanadium permendur.

16. The magnetic separator of Claim 12 wherein the rare-earth permanent magnetic materials are selected from the group consisting of neodymium-iron-boron and samarium-cobalt materials.

17. The magnetic separator of Claim 5 further comprising a flux return yoke.

18. The magnetic separator of Claim 17 wherein the yoke comprises a highly permeable soft magnetic material.

19. The magnetic separator of Claim 17 wherein the yoke comprises vanadium permendur.

20. The magnetic separator of Claim 1 comprising a pair of inhomogeneous magnets each having a pole surface, wherein the pole surfaces are separated by a gap through which pass charged particle beams.

21. The magnetic separator of Claim 20 wherein the magnetic field decreases as a function of the distance from entrance of the magnet.

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22. The magnetic separator of Claim 1 comprising a plurality of magnets dispersed in two parallel arrays separated by a gap through which pass charged particle beams.

23. The magnetic separator of Claim 22 wherein the magnetic field decreases as a function of the distance from entrance of the magnet.

24. The magnetic separator of Claim 22 wherein the gap separating the magnetic arrays increases at a rate along the path of the charged particle beams such that the magnetic field decreases as a function of the distance from entrance of the magnet.

25. The magnetic separator of Claim 1 wherein the inhomogeneous magnetic field is produced from an electric coil.

26. The magnetic separator of Claim 25 wherein the magnetic field decreases as a function of the distance from entrance of the magnet.

27. A method for linearly dispersing charged particles by their mass-energy-to-charge ratios, comprising introducing charged particles into an inhomogeneous magnetic field produced by a magnetic separator that provides a linear dispersion of the charged particles proportional to their mass-energy-to-charge ratio.

28. The method of Claim 27 wherein the linear dispersion of charged particles proportional to their mass-energy-to-charge ratio is achieved by an inhomogeneous magnetic field in one plane and a homogeneous magnetic field in another plane.

29. The method of Claim 27 wherein the linear dispersion of the charged particles proportional to their mass-energy-to-charge ratio is along a predetermined plane.

30. The method of Claim 27 further comprising providing a transverse gradient magnetic field for focusing uncollimated charged particle beams.

31. The method of Claim 27 wherein the magnetic field varies according to the function $B(x) = B_0 x^{-3/4}$, where B_0 is a magnetic field constant chosen to

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match a nominal magnetic field and X is a distance measured along the separator's centerline axis.

32. The method of Claim 27 wherein the magnetic separator comprises a single magnet.

33. The method of Claim 32 wherein the magnet comprises two poles separated by a gap through which pass charged particle beams.

34. The method of Claim 33 wherein the gap between the poles varies according to the function $g(x) = \tan(x^{-1/4})$, where x is a distance measured along the pole surface.

35. A method for achieving a linear dispersion magnetic separator comprising integrating the charged particles' equations of motion in a target magnetic field and adjusting the target magnetic field to match desired charged particle trajectories.

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